



SIBW Monitored Natural Attenuation Monitoring Report

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Subject: **Monitored Natural Attenuation Monitoring Report, Annual Sampling Event 2014, South Indian Bend Wash Superfund Site, Tempe, Arizona**

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1.0 INTRODUCTION AND BACKGROUND

Gilbane Federal (Gilbane) has prepared this Monitored Natural Attenuation Monitoring Report on behalf of the United States Environmental Protection Agency (EPA), Region 9. This report summarizes the results of the 2014 annual groundwater sampling event conducted in October for the South Indian Bend Wash Superfund Site (SIBW) in Tempe, Arizona. Gilbane conducted these activities under Remedial Action Contract (RAC) EP-S9-08-03, Task Order 0008. Two previous technical memorandums reduced both the number of groundwater monitoring wells sampled and the frequency that groundwater monitoring wells are sampled. The EPA approved Technical Memorandum - Modification of Sampling Frequency, South Indian Bend Superfund Site, Tempe, Arizona (ITSI Gilbane, 2013) reduced the sampling frequency from semi-annual to annual, and reduced the number of wells included in the sampling program from 41 to 21 groundwater monitoring wells. The EPA approved Technical Memorandum - Modification of Groundwater Sampling Composition, South Indian Bend Wash Superfund Site, Tempe, Arizona (Gilbane Federal, 2014a) further reduced the number of groundwater monitoring wells sampled for contaminants of concern from 21 to 12.

Twenty-one groundwater monitoring wells remain in the SIBW groundwater monitoring program. Depth to water measurements are collected from all 21 groundwater monitoring wells in order to provide a more accurate determination of groundwater flow and direction. The 21 wells included in the sampling program are shown on **Figure 1**. The 12 wells that are sampled for contaminants of concern are designated on **Figure 1** with colors corresponding to their respective analytical results from the October 2014 sampling event; the wells shown in grey represent wells that are not sampled, but are still used for collection of depth to water values.

1.1 Background

Groundwater contamination was discovered at the Indian Bend Wash (IBW) Site in 1981, when elevated levels of volatile organic compounds (VOCs) including trichloroethene (TCE), tetrachloroethene (also known as perchloroethene [PCE]), and chloroform were found in Scottsdale-area drinking water wells. EPA and the Arizona Department of Environmental Quality (ADEQ) have been involved in investigations and cleanup activities at the SIBW Site since the initial discovery of VOCs in the groundwater in 1981. The IBW Site was placed on the National Priority List (NPL) in 1983 and, as part of the strategy developed to remediate the Site, IBW was divided into the North IBW (NIBW) and the SIBW areas.

On September 30, 1998, EPA issued a Record of Decision (ROD) defining the remedies to address VOCs in groundwater in the SIBW western, central, and eastern plumes. Monitored natural attenuation (MNA) was selected for the central and eastern plumes. Groundwater extraction and treatment was selected for the western plume because in 1998, EPA did not have sufficient data to demonstrate that the contaminant levels in the western plume were decreasing by natural attenuation and that cleanup standards could be met within a reasonable time frame.

Since that time, EPA has gathered a significant amount of groundwater data for the western plume, including data from three monitoring wells installed in 2001. A ROD Amendment was developed and finalized in September 2004 to document the change of remedy for the western plume from extraction and treatment to MNA.

The SIBW Site, shown on Figure 1, includes approximately three square miles of groundwater for cleanup. As defined by the 1998 ROD, the Site is bounded by Apache Boulevard to the south, Rural Road to the west, Loop 101-Price Freeway to the east, and the Salt River to the north. The SIBW Site includes land developed for residential, commercial, and industrial uses. The area between Apache Boulevard and University Drive is primarily residential. North of University Drive, the Site is largely retail and commercial, including light industrial and auto repair/scrap facilities. Industrial activities in the area include circuit and electronics manufacturing, metal plating, plastics manufacturing, and dry cleaning.

The groundwater table has fluctuated more than 50 feet at the Site over the last twenty years (See Section 2.3). These fluctuations in groundwater levels can either leave residual areas of contamination when the water table falls, or cause vadose zone contaminants to become dissolved in the groundwater when the groundwater table rises (EPA ROD, 1998). The geologic formations underlying the SIBW are divided into three alluvial units, designated as the Upper Alluvial Unit (UAU), Middle Alluvial Unit (MAU), and Lower Alluvial Unit (LAU). These units are described below.

1.1.1 Upper Alluvial Unit

The UAU is distributed across the entire SIBW area, and generally has a uniform thickness. The UAU typically is found near or at the ground surface and extends to approximately 110 to 170 feet below ground surface (bgs). The UAU normally is divided into an upper layer of clay and sandy silt and a lower layer dominated by sand, gravel, cobbles, and boulders. The upper layer typically is not present near the Salt River channel, and thickens to more than 20 feet south of the channel. The 1998 ROD established the compliance boundary for the central and western UAU areas of contamination approximately 2,000 feet south of Broadway Road, bounded by Loop 101-Price Freeway to the east and Dorsey Lane to the west.

Groundwater flow directions in the UAU are south to southwest during non-river flow conditions in the Salt River. Flow directions shift to the south to southeast during river flow conditions in the Salt River, when aquifer recharge influences groundwater flow. Groundwater flow through the UAU originates mainly from Salt River recharge (during flow events); lateral inflow moves vertically downward, eventually entering the MAU.

1.1.2 Middle Alluvial Unit

The MAU consists primarily of clay and sandy silt, with significant interbedded layers of sand-gravel mixtures. These coarser-grained interbedded layers generally represent the zones with higher hydraulic conductivity in the MAU. Weak to strong calcium carbonate cementation also is present in the MAU. The interbedded stratigraphy encountered within the MAU is subdivided into subunits A, B, and C. MAU Subunit A is very thin and discontinuous; consequently, no EPA wells are screened in this subunit. The 1998 ROD also established the compliance boundary for the MAU areas of contamination approximately 2,000 feet east of monitoring well SIBW-57MC, bounded on the north by Rio Salado Parkway and on the south by Apache Boulevard.

The groundwater flow direction in MAU Subunit B generally is west to east, but insufficient data exist to characterize the flow direction fully. The groundwater flow direction in MAU Subunit C varies from due north to east, with northeast appearing to be the predominant flow direction.

1.1.3 Lower Alluvial Unit

The LAU underlies the MAU and, for most of the SIBW area, exceeds the depths explored during the remedial investigation (RI). The LAU extends from approximately 500 feet bgs to an undetermined depth in the SIBW (the base of the LAU typically was not encountered in RI soil borings). The lithology of the LAU is consistent with that of a conglomerate, dominated by weakly cemented gravel, sand, silt, and rock fragments. Groundwater flow directions in the LAU cannot be estimated accurately using the limited existing data.

1.2 Groundwater Plumes

Groundwater samples are collected and analyzed and groundwater elevations are calculated on an annual basis for the SIBW Site. The contaminants of concern, as established in the ROD, are cis-1,2-dichloroethene (cis-1,2-DCE), PCE, and TCE. All contaminants of concern have been reported at concentrations near or below their respective EPA drinking water maximum contaminant levels (MCLs) in recent Site groundwater samples. The EPA MCLs match the Arizona Aquifer Water Quality Standards (AWQSs) for drinking water. The MCLs for the Site contaminants of concern are as follows:

- PCE = 5 micrograms per liter (ug/L).
- TCE = 5 ug/L.
- cis-1,2-DCE = 70 ug/L.

The primary contaminant of concern in the western and eastern plumes is TCE, whereas the primary contaminant of concern in the central plume is PCE. cis-1,2-DCE has been detected in the eastern plume, and is believed to be a byproduct of TCE dechlorination. Monitoring well locations associated with the SIBW Site are shown on **Figure 1**.

1.3 Enhanced Attenuation Study

Gilbane performed an Enhanced Attenuation Study at five wells within the MAU Eastern Plume. The TCE detections from these five wells were above the MCL. It was determined by modeling that the TCE concentration in these five wells likely would not drop below the MCL for 10 to 30 years with the selected remedy of MNA. In an attempt to reduce TCE concentrations expeditiously, in-situ chemical oxidation (ISCO) was performed through the injection of an oxidant (sodium permanganate) into MAU wells SW-3, SIBW-11MC, SIBW-13MC, SIBW-56MC, and SIBW-58MC. Baseline sampling was performed prior to ISCO injections in March 2013. Injections were performed in June 2013. Ongoing post-ISCO sampling is being performed to determine the long-term effectiveness of the MNA remedy enhancement. Samples are analyzed for VOCs, sodium, manganese, and chromium. Four rounds of post-ISCO sampling were performed in August and November 2013, and February and May 2014. Initially, injections were successful in lowering TCE concentrations below the MCL at these five wells. Laboratory analytical results for the baseline and post-ISCO sampling events are included in **Table 1**. Further details of the study are included in the Technical Memorandum - Results for the Middle Alluvial (MAU) Enhanced Attenuation Study, South Indian Bend Wash (SIBW) Superfund Site, Tempe, Arizona (Gilbane, 2014b).

2.0 OCTOBER 2014 ANALYTICAL RESULTS

Groundwater sampling at SIBW was conducted in accordance with the sampling frequencies identified in Table 5-2 (Modified) of the Technical Memorandum - Modification of Groundwater Sampling Composition (Gilbane Federal, 2014a). The 2014 annual sampling event was conducted from October 19 through October 22, 2014.

Laboratory analytical results for the contaminants of concern associated with SIBW reported in samples collected for the annual sampling event of 2014 are presented in **Table 2**. Detections of contaminants of concern at concentrations greater than or equal to 1.0 ug/L from this event were used to create the approximate PCE and TCE concentration contours shown on **Figure 2**, Groundwater Contaminant Concentration Map.

Prior to sampling, depth-to-water measurements were collected from the 21 wells currently included in the SIBW groundwater sampling program. These depth-to-groundwater measurements were used to create groundwater potentiometric maps for the UAU (**Figure 3-A**) and for the MAU (**Figure 3-B**). Groundwater samples were collected using dedicated pumps, with the exception of SIBW-65U. The dedicated pump in well SIBW-65U was not operating, and the sample from this well was collected using a disposable bailer.

2.1 Analytical Data Assessment

Groundwater samples were analyzed for trace VOCs using EPA Contract Laboratory Program (CLP) Method SOM01.2 by Shealy Environmental Services, in West Columbia, South Carolina. VOC samples from wells where ISCO injections were performed (SW-3, SIBW-11MC, SIBW-13MC, SIBW-56MC, and SIBW-58MC) were collected in ascorbic acid-preserved VOA vials. Ascorbic acid acts as a preservative that neutralizes the residual sodium permanganate in the VOA vial. The holding time for the VOC samples preserved with ascorbic acid is seven days. Samples from all other wells, trip blanks, and equipment blanks were collected in VOA vials preserved with hydrochloric acid, which has a 14 day holding time.

The laboratory missed the seven-day holding time for the five samples preserved with ascorbic acid by three to four days. Data validation performed on the analytical results from these five samples resulted in “J” flags for the positive analytical results due to the holding time anomaly. The rationale for preservation from biological degradation of all compounds is spelled out in SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 1980). Specifically, Chapter Four, Organic Analytes, Section 4.1.2 of SW-846 indicates the following regarding chlorinated volatile compounds: “Samples for which chlorinated aliphatic hydrocarbons are the only target analytes generally do not need to be preserved”. The contaminants of concern for the project are the are chlorinated hydrocarbons TCE, PCE, and cis-1,2 DCE.

Although the samples were analyzed for the full list of VOCs, the compounds of interest for this project are the three chlorinated hydrocarbons listed above. These chlorinated hydrocarbons do not require qualification for holding times anomalies and remain useable for their intended purpose of monitoring the progress of MNA. The results of the other hydrocarbon types (aromatic, brominated, fluorinated etc.) are not target compounds and data use is not an issue.

Although there is no need to preserve the samples for chlorinated hydrocarbon analysis, Gilbane will preserve samples with ascorbic acid followed with hydrochloric acid to allow a full 14-day contract laboratory analysis time between sample collection and analysis.

2.2 Contaminant of Concern Analytical Results

Table 2 presents the analytical results for the contaminants of concern for the 12 groundwater monitoring wells sampled. All results less than the method detection limit are considered non-detect. Results between the method detection limit and the laboratory reporting limit (0.5 ug/L), are considered trace level and estimated results. These trace-level results are shown on **Figure 2**, but were not used in the determination of the PCE and TCE concentration contours. To remain consistent with previous sampling events, only results greater than or equal to 1.0 ug/L were used to create the PCE and TCE concentration contours shown on **Figure 2**.

The highest concentration of TCE was detected in monitoring well SW-3 at 6.3 ug/L which is above the MCL of 5 ug/L. The highest concentration of PCE was detected in monitoring well SIBW-61U at 4.5 ug/L which is below the MCL of 5 ug/L. Results for the annual sampling event for 2014 are summarized below.

cis-1,2-DCE was detected in two monitoring wells, both in the MAU, at concentrations above the laboratory reporting limit of 0.5 ug/L but less than the MCL of 70 ug/L. These include SIBW-58MC at 0.79 ug/L and SW-3 at 1.4 ug/L. **cis-1,2-DCE** was detected in three monitoring wells within the MAU eastern plume during the September 2012 sampling event. There were no detections of **cis-1,2-DCE** in the November 2013 sampling event; a result of ISCO injections performed in June 2013.

PCE was detected in six monitoring wells in the UAU central plume at concentrations greater than 0.5 ug/L but less than the MCL of 5 ug/L. These monitoring wells were PD-2 at 0.84 ug/L, SIBW-60U at 1.4 ug/L, SIBW-61U at 4.5 ug/L, SIBW-64U at 0.82 ug/L, SIBW-66U at 1.6 ug/L, and SW-1 at 0.93 ug/L.

PCE was detected in two monitoring wells in the MAU eastern plume at concentrations greater than 0.5 ug/L, but less than the MCL of 5 ug/L. These monitoring wells were SIBW-58MC at 0.58 ug/L and SW-3 at 0.73 ug/L. **PCE** was not detected above 0.5 ug/L within the MAU eastern plume during the last sampling event; a result of ISCO injections performed in June 2013.

TCE was detected in one monitoring well in the UAU western plume at a concentration greater than 0.5 ug/L, but less than the MCL of 5 ug/L. This monitoring well was SIBW-60U at 1.4 ug/L.

TCE was detected in four monitoring wells located in the MAU eastern plume at concentrations greater than 0.5 ug/L but less than the MCL of 5 ug/L.

These monitoring wells were SIBW-11MC at 3.4 ug/L, SIBW-13MC at 1.2 ug/L, SIBW-56MC at 2.2 ug/L, and SIBW-58MC at 4.7 ug/L. TCE was detected in one monitoring well in the MAU eastern plume at concentrations greater than the MCL of 5 ug/L; SW-3 at 6.3 ug/L. TCE was detected in three monitoring wells above the MCL in the September 2102 sampling event prior to ISCO injections. TCE was not detected above the MCL in the November 2013 sampling event as a result of ISCO injections performed in June 2013.

Trend plots showing contaminants of concern concentrations and groundwater elevations over time for each of the 12 wells that are still sampled annually are included as Figures 4-A through 4-L. The date range in each of these Figures differs, depending on when the well was installed.

2.2.1 Western Plume

TCE is the primary contaminant of concern in the groundwater in the UAU western plume. The UAU western plume originally was defined by monitoring wells SIBW-5U, SIBW-23U, SIBW-24U, SIBW-40U, and SIBW-28U. Due to plume migration, the western plume is no longer defined by these wells and they have been removed from the sampling program with the exception of SIBW-5U and SIBW-28U. These two wells are no longer sampled, but are used for depth-to-water measurement to determine groundwater flow and direction. Wells SIBW-60U and SIBW-64U were installed as downgradient sentinel wells for the UAU central plume, and are considered representative wells for both the UAU central and western plumes. Recently, TCE has been detected downgradient from SIBW-28U in monitoring well SIBW-60U. **Figure 2** illustrates the current estimated extent of the TCE in the UAU western plume.

TCE was detected in well SIBW-60U at 1.4 ug/L (the highest concentration of TCE detected in the UAU western plume during this sampling event) and in well SIBW-64U at 0.13 ug/L (estimated result). Well SIBW-60U showed a decrease in TCE concentration from March 2012 (1.6 ug/L) to September 2012 (1.1 ug/L) and November 2013 (1.1 ug/L), but increased this sampling event. TCE concentration trend plots and groundwater elevations (discussed in **Section 2.3**) for monitoring well SIBW-60U are shown on **Figure 4-A**.

The following table lists the TCE detections for the UAU western plume for the last four sampling events. Note that none of the concentrations exceed the MCL of 5 ug/L for TCE.

UAU Western Plume WELL	TCE (ug/L)			
	Mar-12	Sep-12	Nov-13	Oct-14
SIBW-5U	0.48 J	0.54	0.5	N/A
SIBW-28U	0.75	0.76	0.46 J	N/A
SIBW-60U	1.6	1.1	1.1	1.4
SIBW-64U	1.0	0.17 J	0.16 J	0.13 J
Regulatory Criteria (ug/L)				
MCL	5			

J = estimated result

MCL = Maximum Contaminant Level

N/A = not analyzed (not sampled), well no longer in the active sampling program

TCE = trichloroethene

ug/L = micrograms per liter

2.2.2 Central Plume

PCE is the primary contaminant of concern present in the UAU central groundwater plume. The UAU central plume currently is defined by multiple wells, including five wells located south of the compliance boundary: SIBW-60U, SIBW-61U, SIBW-64U, SIBW-65U, and SIBW-66U. PCE concentration trend plots and groundwater elevations for these monitoring wells are shown on **Figures 4-A** through **4-E**, respectively. Monitoring wells SIBW-38U, SIBW-39U, and SIBW-59U, which were historically located in the central plume, have been removed from the sampling program.

The concentration of PCE detected in well SIBW-60U samples increased from November 2013 (1.1 ug/L) to 1.4 ug/L the 2014 sampling event (see **Figure 4-A**). PCE has been detected in well SIBW-61U at concentrations above the MCL in past monitoring events, most recently in March 2011 (see **Figure 4-B**). SIBW-61U had shown a decreasing trend in PCE concentration in the previous two sampling events, but increased to 4.5 ug/L the 2014 sampling event. This was the highest PCE concentration reported for any groundwater monitoring well sampled in the 2014 event. The concentration of PCE from well SIBW-64U has decreased over the last four sampling events from March 2012 (4.7 ug/L) to 0.82 ug/L the 2014 sampling event (see **Figure 4-C**). PCE was detected in well SIBW-65U at a concentration above the MCL in May 2006 (see **Figure 4-D**). The PCE concentration in well SIBW-65U decreased from 0.88 ug/L in November 2013 to 0.36 ug/L (estimated result) in the 2014 sampling event.

Well SIBW-66U was installed most recently. It was placed downgradient of the western and central UAU plumes and south of monitoring well SIBW-65U. PCE detected in SIBW-66U increased from 1.4 ug/L in September 2010, when it was first sampled, to 1.7 ug/L in March 2011 (see **Figure 4-E**).

The PCE concentration decreased to 1.1 ug/L in the September 2012 sampling event, but increased to 1.2 ug/L in the November 2013 sampling event and increased again to 1.6 ug/L in the 2014 sampling event.

Monitoring wells PD-2 and SW-1 are located to the northeast of the current central plume location. For the 2014 sampling event, PCE was detected in well PD-2 at a concentration of 0.84 ug/L and in well SW-1 at a concentration of 0.93 ug/L. Monitoring wells PD-2 and SW-1 historically had detections of PCE above the MCL. However, as presented on **Figures 4-F and 4-G**, respectively, these wells have shown a downward trend, and PCE concentrations have been below the MCL of 5 ug/L since April 2001 and January 2005, respectively.

The following table lists the PCE detections for the UAU central plume for the last four sampling events.

UAU Central Plume WELL	PCE (ug/L)			
	Mar-12	Sep-12	Nov-13	Oct-14
PD-2	0.69	0.62	0.73	0.84
SIBW-38U	0.21 J	0.22 J	< 0.50	N/A
SIBW-39U	0.63	0.64	0.65	N/A
SIBW-59U	< 0.50	0.14 J	0.062 J	N/A
SIBW-60U	1.2	1.0	1.1	1.4
SIBW-61U	4.2	3.8	3.6	4.5
SIBW-64U	4.7	1.5	0.89	0.82
SIBW-65U	1.2	0.21 J	0.88	0.36 J
SIBW-66U	1.2	1.1	1.2	1.6
SW-1	< 0.50	0.75	0.75	0.93
Regulatory Criteria (ug/L)				
MCL	5			

J = estimated result

MCL = Maximum Contaminant Level

N/A = not analyzed (not sampled), well no longer in the active sampling program

PCE = tetrachloroethene

ug/L = micrograms per liter

< 0.50 = less than the method detection limit (non-detect)

2.2.3 Eastern Plume

TCE is the primary contaminant of concern in the groundwater in the MAU eastern plume. PCE has also been detected in the area in both the UAU and the MAU at concentrations below the MCL. ISCO injections were performed in June 2013 at wells SW-3, SIBW-11MC, SIBW-13MC, SIBW-56MC, and SIBW-58MC.

Four wells sampled in the 2014 sampling event in the MAU eastern plume had TCE concentrations above the reporting limit of 0.5 ug/L, but below the MCL of 5 ug/L: SIBW-11MC at 3.4 ug/L, SIBW-13MC at 1.2 ug/L, SIBW-56MC at 2.2 ug/L, and SIBW-58MC at 4.7 ug/L. One well sampled in the 2014 sampling event in the MAU eastern plume had a TCE concentration above the MCL; SW-3 at 6.3 ug/L. The TCE concentration in all five of these wells increased from the previous sampling event in November 2013. Rebound in TCE concentrations following ISCO treatment indicates that some residual TCE still is present in the MAU eastern plume. Because ISCO destroys dissolved TCE, the observed TCE concentration rebound following ISCO treatment is likely attributable to the dissolution of sorbed-phase TCE that regularly occurs following ISCO implementation. In addition, because of the uncertain radius of influence of the ISCO injections, dissolved TCE outside of the extent of the ISCO injections could have migrated to the wells during the post-ISCO sampling period and contributed to the observed TCE rebound. The TCE concentrations in these monitoring wells remain lower than the concentrations observed in March 2012 and September 2012 (prior to ISCO injections). Monitoring wells SIBW-55MC and SIBW-57MC have been removed from the sampling program.

Groundwater monitoring well SIBW-58MC was sampled in October 2014, but was destroyed in December 2014 during construction activities by a new property owner. Future groundwater samples will be collected from nearby well SIBW-13MC to provide representative groundwater data in the vicinity of groundwater monitoring well SIBW-58MC.

TCE and PCE concentration trend plots and groundwater elevations for monitoring wells SIBW-11MC, SIBW-13MC, SIBW-56MC, SIBW-58MC, and SW-3 are shown on **Figures 4-H** through **4-L**, respectively. **Figure 2** illustrates the extent of TCE in the MAU eastern plume. The following table lists the TCE detections for the MAU eastern plume for the last four sampling events.

MAU Eastern Plume WELL	cis-1,2-DCE (ug/L)				TCE (ug/L)			
	Mar-12	Sep-12	Nov-13	Oct-14	Mar-12	Sep-12	Nov-13	Oct-14
SIBW-11MC	1.0	0.7	0.070 J	0.49 J	5.3	5.9	0.69 J*	3.4 J*
SIBW-13MC	0.30 J	0.29 J	0.097 J	0.18 J	2.0	2.3	0.69 J*	1.2 J*
SIBW-55MC	< 0.50	< 0.50	< 0.50	N/A	< 0.50	< 0.50	< 0.50	N/A
SIBW-56MC	0.52	0.47 J	0.037 J	0.26 J	2.9	3.6	0.42 J	2.2 J*
SIBW-57MC	< 0.50	< 0.50	< 0.50	N/A	< 0.50	< 0.50	0.16 J	N/A
SIBW-58MC	1.3	1.1	0.25 J	0.79	5.7	7.2	1.6 J*	4.7 J*
SW-3	1.6	1.2	0.41 J	1.4	7.1	5.6	2.2 J*	6.3 J*
Regulatory Criteria (ug/L)								
MCL	70				5			

cis-1,2-DCE = cis-1,2-dichloroethene

J = estimated result

J* = estimated result due to analysis outside holding time

MCL = Maximum Contaminant Level

N/A = not analyzed (not sampled), well no longer in the active sampling program

TCE = trichloroethene

ug/L = micrograms per liter

< 0.50 = less than the method detection limit (non-detect)

= result above the MCL

2.3 Groundwater Elevation and Flow Direction Evaluation

Based on data from representative wells screened in the UAU and the MAU, groundwater elevations generally declined between 1994 and 2004 in both alluvial units. However, between 2004 and 2014, elevations in representative SIBW wells screened in the UAU and MAU have risen. Elevations in the UAU monitoring wells have risen from 31 to 35 feet, while elevations in the MAU wells have risen from 70 to 90 feet during this time period. These trends can be seen in the groundwater elevation trend plots included on **Figures 4-A** through **4-L**.

Groundwater contours were developed using groundwater elevations calculated from depth-to-water measurements taken at each of the 21 monitoring wells currently included in the SIBW groundwater sampling program. Groundwater elevation contours on **Figure 3-A** show that the groundwater flow direction in the UAU is to the south-southwest. That is consistent with historical data showing the groundwater flow direction in the UAU being influenced by seasonal flow in the Salt River. When the Salt River is flowing, the groundwater flow direction in the UAU shifts from the south-southwest to the south-southeast (EPA ROD, 1998).

The 1998 ROD stated that the groundwater flow direction in the MAU was inconclusive; however, a general trend to the east was noted. Groundwater elevation contours on **Figure 3-B** show that the current groundwater flow direction in the MAU varies from north-northeast to north-northwest.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Concentrations of all contaminants of concern in the UAU western plume continue to remain below the MCL. The highest TCE concentration detected in 2014 in the UAU western plume monitoring wells was collected from SIBW-60U. The TCE concentration in monitoring well SIBW-60U increased from 1.1 ug/L in November 2013 to 1.4 ug/L this sampling event.

All concentrations of contaminants of concern in the UAU central plume have been below the MCL for the last five sampling events. The PCE concentration in well SIBW-61U has decreased, from above the MCL in March 2011, to below the MCL for the last five sampling events (4.6 ug/L, 4.2 ug/L, 3.8 ug/L, 3.6 ug/L, and 4.5 ug/L, respectively).

After decreasing for four sampling events, the PCE concentration in SIBW-61U increased in the 2014 sampling event. The PCE concentration in well SIBW-64U continues to decrease from 4.7 ug/L in March 2012, to 1.5 ug/L in September 2012, to 0.89 ug/L in November 2013, to 0.82 ug/L in the 2014 sampling event.

Ongoing post-ISCO sampling is being performed in the MAU eastern plume to identify additional post injection rebound of concentrations of chemicals of concern. In response to ISCO injections the concentrations of TCE in wells SIBW-11MC, SIBW-13MC, SIBW-56MC, SIBW-58MC, and SW-3 in the eastern plume decreased in the November 2013 sampling event. TCE concentrations in all wells in the MAU eastern plume were below the MCL of 5 ug/L during the November 2013 sampling event. However, TCE concentrations have rebounded in the 16 months since ISCO injections. The TCE concentration in monitoring well SW-3 rebounded back above the MCL in the 2014 sampling event at 6.3 ug/L. TCE was also detected in concentrations above 0.5 ug/L but below the MCL of 5 ug/L in the other four wells where ISCO injections were performed. TCE concentrations in these five wells remain lower than the concentrations observed prior to ISCO injections.

Groundwater contours show the groundwater flow direction in the UAU is to the south-southwest, which is consistent with historical data. Groundwater elevation contours for the MAU show groundwater flowing from north-northeast to north-northwest, indicating that surrounding development may be influencing the flow pattern.

Since 2004, groundwater elevations in representative SIBW wells screened in the UAU and the MAU have risen. Groundwater elevations in monitoring wells measured during the 2014 event have risen from 31 to 34 feet in the UAU, and the groundwater elevations in the MAU have risen from 71 to 79 feet, over this ten-year period.

Gilbane has abandoned all wells associated with SIBW with the exception of the 21 wells that are currently in the sampling program. Gilbane recommends continuation of the current sampling program, and that the 12 wells remaining in the active sampling program be sampled in the 2015 annual sampling event. Gilbane recommends that if concentrations of contaminants remain at the levels currently observed the site should be evaluated for closure. This would include the abandonment of the remaining 21 monitoring wells in early 2016.

The next sampling event in the Annual Groundwater Monitoring Program is scheduled for Fall 2015.

4.0 REFERENCES

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TABLES

TABLE 1
Groundwater Sampling Analytical Results
Results from Middle Alluvial Unit Enhanced Attenuation Study
South Indian Bend Wash Superfund Site
Tempe, Arizona

5th Post ISCO Sampling Event (October 2014)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
SIBW-11MC	13.7		219,000		526		0.49 J	0.41 J	3.4
SIBW-13MC	9.7		213,000		1,340		0.18 J	0.27 J	1.2
SIBW-56MC	8.4		176,000		4,090		0.26 J	0.42 J	2.2
SIBW-56MC DUP	8.9		168,000		3,780		0.32 J	0.41 J	2.2
SIBW-58MC	10.7		177,000		1,060		0.79	0.58 J	4.7
SW-3	10.7		170,000		1,290		1.4	0.73	6.3

4th Post ISCO Sampling Event (May 2014)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
	CLP	TA	CLP	TA	CLP	TA			
SIBW-11MC	15.8	19	198,000	210,000	840	900	0.34 J	0.34 J	2.5
SIBW-13MC	7.1	8.8	201,000	220,000	796	950	0.14 J	0.23 J	1.1
SIBW-13MC DUP	7.2	N/A	201,000	N/A	868	N/A	0.15 J	0.24 J	1.1
SIBW-56MC	11.4	13	179,000	200,000	7,970	7,900	0.19 J	0.30 J	1.4
SIBW-57MC	1.2 J	2.2	129,000	150,000	43.6	55	< 0.50	0.12 J	0.43 J
SIBW-58MC	10.7	13	163,000	170,000	1,550	1,700	< 0.50	0.47 J	3.6
SW-2	0.52 J	< 2.0	191,000	210,000	5.6	10	< 0.50	0.044 J	0.055 J
SW-3	11.9	14	165,000	180,000	2,870	2,800	1.0	0.66	4.9

3rd Post ISCO Sampling Event (February 2014)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
SIBW-11MC	40.4		192,000		4,320 J		0.22 J	0.26 J	2.0
SIBW-11MC DUP	37.7 J		210,000		4,690 J		0.31 J	0.36 J	2.6
SIBW-13MC	11.2 J		211,000		1,660 J		0.15 J	0.22 J	1.10
SIBW-56MC	30.7		178,000		14,200 J		< 0.50	0.33 J	1.1
SIBW-57MC	3.7 J		125,000		49.7 J		< 0.50	< 0.50	0.28 J
SIBW-58MC	17.1 J		172,000		2,800 J		0.56	0.45 J	3.4
SW-2	1.4 J		184,000		13.8 J		< 0.50	< 0.50	< 0.50
SW-3	28.1		184,000		5,790 J		0.98	0.66	5.2

2nd Post ISCO Sampling Event (November 2013)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
SIBW-11MC	56.9		252,000		14,100		0.070 J	0.20 J	0.69
SIBW-13MC	17.4		270,000		3,150		0.097 J	0.18 J	0.69
SIBW-56MC	22.8		248,000		31,400		0.037 J	0.29 J	0.42 J
SIBW-57MC	2.0 J		149,000		66		< 0.50	0.095 J	0.16 J
SIBW-58MC	25.7		231,000		1,240		0.25 J	0.42 J	1.6
SIBW-58MC DUP	25.8		233,000		1,310		0.25 J	0.40 J	1.6
SW-2	2.0 J		174,000		6.6		< 0.50	0.050 J	< 0.50
SW-3	23.5		252,000		12,300		0.41 J	0.49 J	2.2

1st Post ISCO Sampling Event (August 2013)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
SIBW-11MC	170		370,000		65,000		< 0.50	< 0.50	< 0.50
SIBW-11MC DUP	150		370,000		61,000		< 0.50	< 0.50	< 0.50
SIBW-13MC	29		340,000		23,000		< 0.50	< 0.50	0.3 J
SIBW-56MC	37		390,000		59,000		< 0.50	< 0.50	< 0.50
SIBW-57MC	1.1		150,000		56		<0.50	<0.50	<0.50
SIBW-58MC	31		310,000		34,000		< 0.50	0.3 J	0.4 J
SW-2	0.81 J		210,000		5.5		< 0.50	<0.50	<0.50
SW-3	37		350,000		43,000		< 0.50	0.5	0.7

Baseline Sampling Event (March 2013)									
WELL	Chromium		Sodium		Manganese		cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
SIBW-11MC	3.0		N/A		N/A		1.1	0.65	7.1
SIBW-11MC DUP	2.9		N/A		N/A		1.0	0.63	6.6
SIBW-13MC	1.8		N/A		N/A		0.38 J	0.38 J	2.5
SIBW-56MC	2.8		N/A		N/A		0.67	0.52	3.6
SIBW-57MC	0.90 J		N/A		N/A		<0.50	<0.50	<0.50
SIBW-58MC	3.8		N/A		N/A		1.7	0.87	8.2
SW-2	0.54 J		N/A		N/A		< 0.50	<0.50	<0.50
SW-3	5.1		N/A		N/A		1.8	0.86	7.3

Criteria (ug/L)									
MCL	100	100	N/A	N/A	50 (SMCL)	50 (SMCL)	70	5	5
Arizona AWQS	100	100	N/A	N/A	N/A	N/A	70	5	5

All results are in micrograms per liter (ug/L)
< 0.50 = result below the laboratory reporting limit (non-detect)
AWQS = Aquifer Water Quality Standard
CLP = Contract Laboratory Program (CLP) Laboratory
ISCO = In-situ chemical oxidation
J = estimated Value
MAU = middle alluvial unit
MCL = maximum contaminant level
N/A = Not applicable/not analyzed
SIBW = South Indian Bend Wash Superfund Site
SMCL = Secondary MCL (guideline - not enforced)
TA = Test America Laboratory (Split Sample)
ISCO Injection Well
Result above the maximum contaminant level

TABLE 2
Groundwater Sampling Analytical Results
Annual Sampling Event 2014

WELL	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
PD-2	< 0.50	0.84	< 0.50
SIBW-11MC	0.49 J	0.41 J	3.4 J*
SIBW-13MC	0.18 J	0.27 J	1.2 J*
SIBW-56MC	0.26 J	0.42 J	2.2 J*
SIBW-56MC (DUP)	0.32 J	0.41 J	2.2 J*
SIBW-58MC	0.79 J*	0.58 J	4.7 J*
SIBW-60U	0.26 J	1.4	1.4
SIBW-60U (DUP)	0.31 J	1.3	1.3
SIBW-61U	< 0.50	4.5	0.075 J
SIBW-64U	< 0.50	0.82	0.13 J
SIBW-65U	< 0.50	0.36 J	< 0.50
SIBW-66U	< 0.50	1.6	< 0.50
SW-1	< 0.50	0.93	< 0.50
SW-3	1.4 J*	0.73 J*	6.3 J*
Criteria (ug/L)			
MCL	70	5	5
Arizona AWQS	70	5	5

All results are in micrograms per liter (ug/L)

< 0.50 = result below the method detection limit (non-detect)

AWQS = Aquifer Water Quality Standard

DUP = duplicate sample

J = estimated result below the laboratory reporting limit

J* = estimated result due to analysis outside holding time

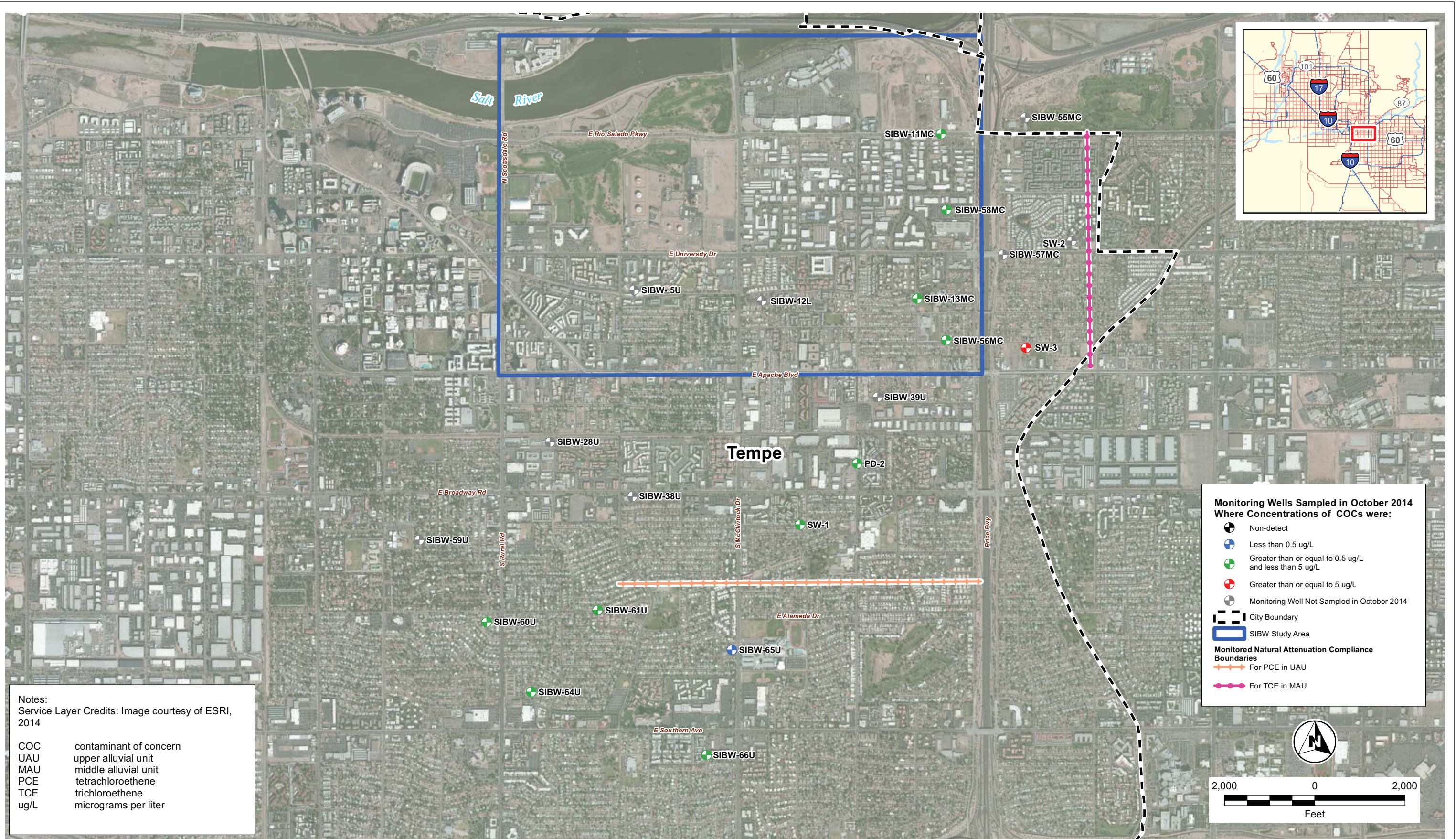
MCL = maximum contaminant level

Well screened in the middle alluvial unit (MAU)

Unhighlighted wells are screened in the upper alluvial unit (UAU)

Result above the maximum contaminant level

FIGURES



SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
 South Indian Bend Wash Superfund Site, US EPA Region 9
 Tempe, Arizona

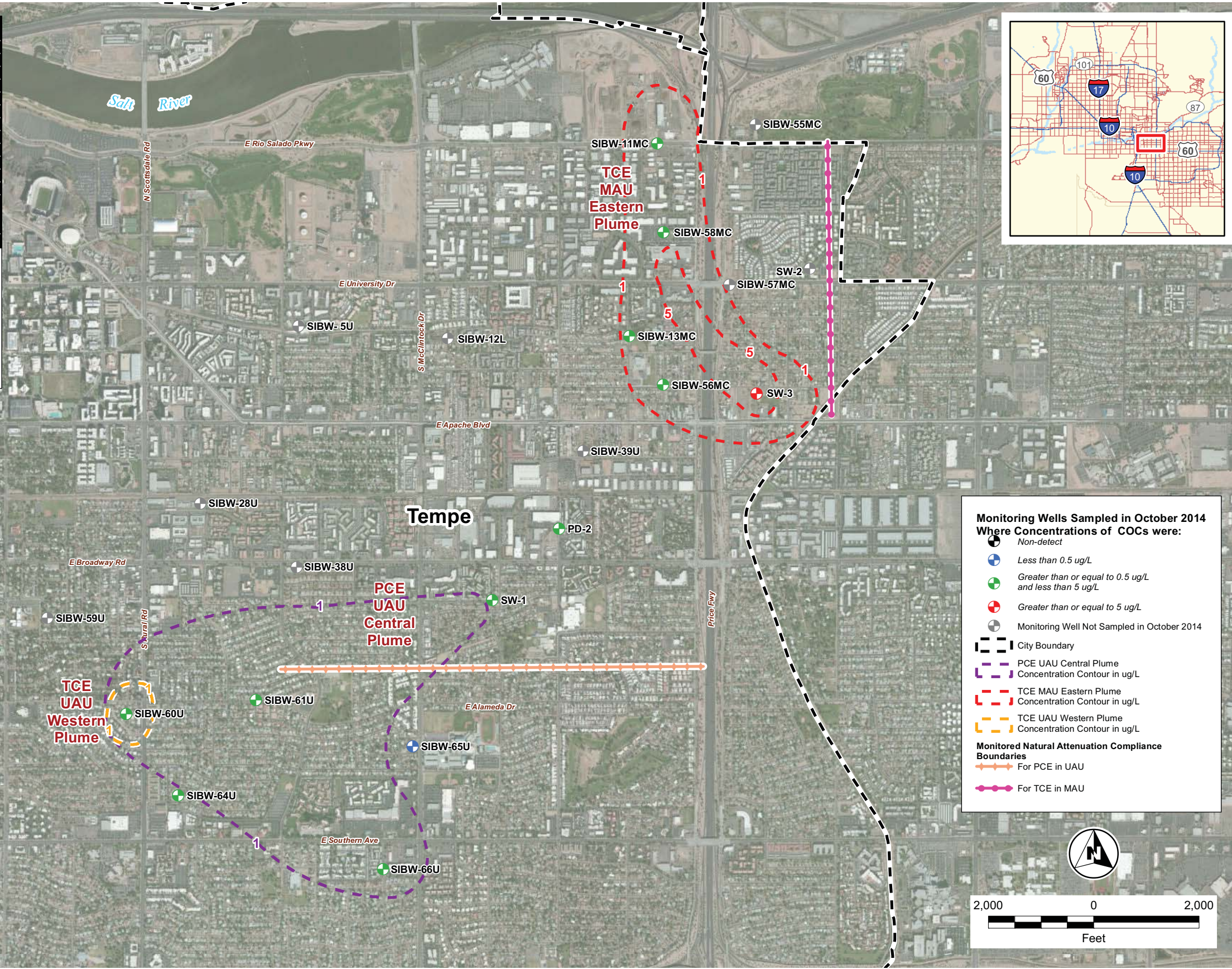
FIGURE 1
 Well Location Map

WELL	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
PD-2	< 0.50	0.84	< 0.50
SIBW-11MC	0.49 J	0.41 J	3.4 J*
SIBW-13MC	0.18 J	0.27 J	1.2 J*
SIBW-56MC	0.26 J	0.42 J	2.2 J*
SIBW-56MC (DUP)	0.32 J	0.41 J	2.2 J*
SIBW-58MC	0.79 J*	0.58 J	4.7 J*
SIBW-60U	0.26 J	1.4	1.4
SIBW-60U (DUP)	0.31 J	1.3	1.3
SIBW-61U	< 0.50	4.5	0.075 J
SIBW-64U	< 0.50	0.82	0.13 J
SIBW-65U	< 0.50	0.36 J	< 0.50
SIBW-66U	< 0.50	1.6	< 0.50
SW-1	< 0.50	0.93	< 0.50
SW-3	1.4 J*	0.73 J*	6.3 J*
Criteria (ug/L)			
MCL	70	5	5
Arizona AWQS	70	5	5

All results are in micrograms per liter (ug/L)
< 0.50 = result below the method detection limit (non-detect)
AWQS = Aquifer Water Quality Standard
DUP = duplicate sample
J = estimated result below the laboratory reporting limit
J* = estimated result due to analysis outside holding time
MCL = maximum contaminant level
Well screened in the middle alluvial unit (MAU)
Unhighlighted wells are screened in the upper alluvial unit (UAU)
Result above the maximum contaminant level

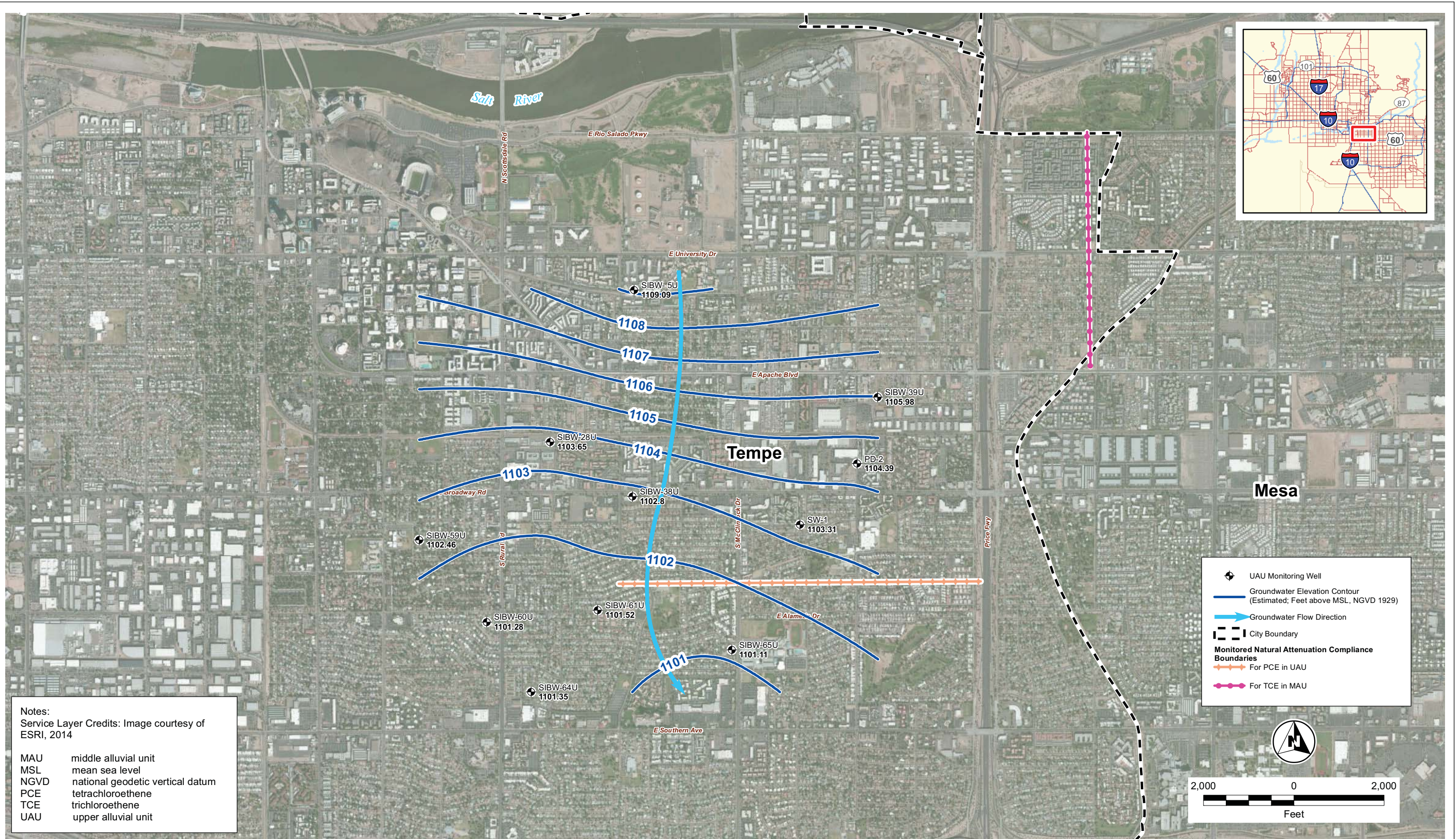
Notes:
Service Layer Credits: Image courtesy of ESRI, 2014

COC	contaminant of concern
UAU	upper alluvial unit
MAU	middle alluvial unit
PCE	tetrachloroethene
TCE	trichloroethene
ug/L	micrograms per liter



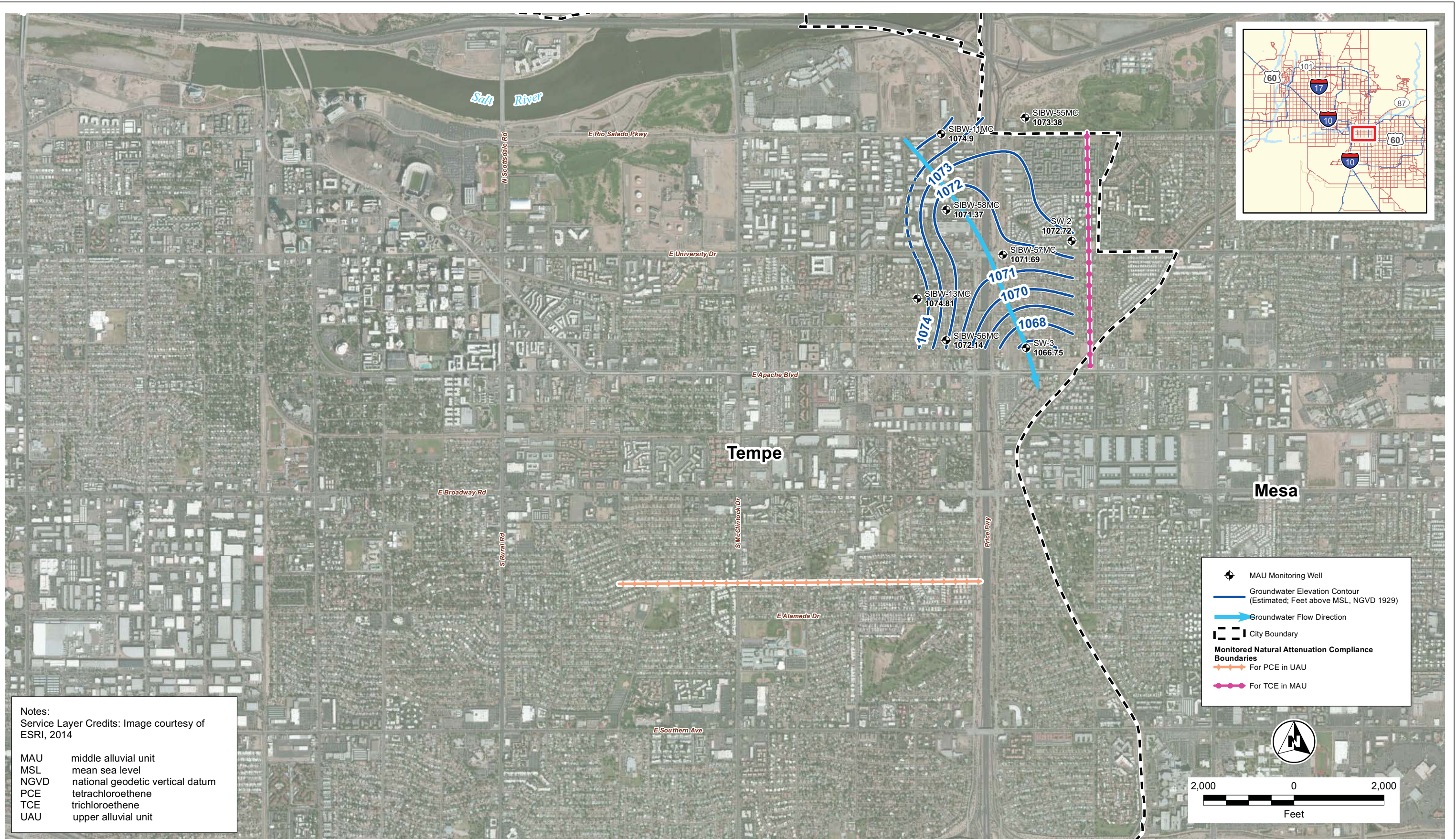
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South Indian Bend Wash Superfund Site, US EPA Region 9
Tempe, Arizona

FIGURE 2
Groundwater Contamination
Concentrations Map
Annual Sampling Event, 2014



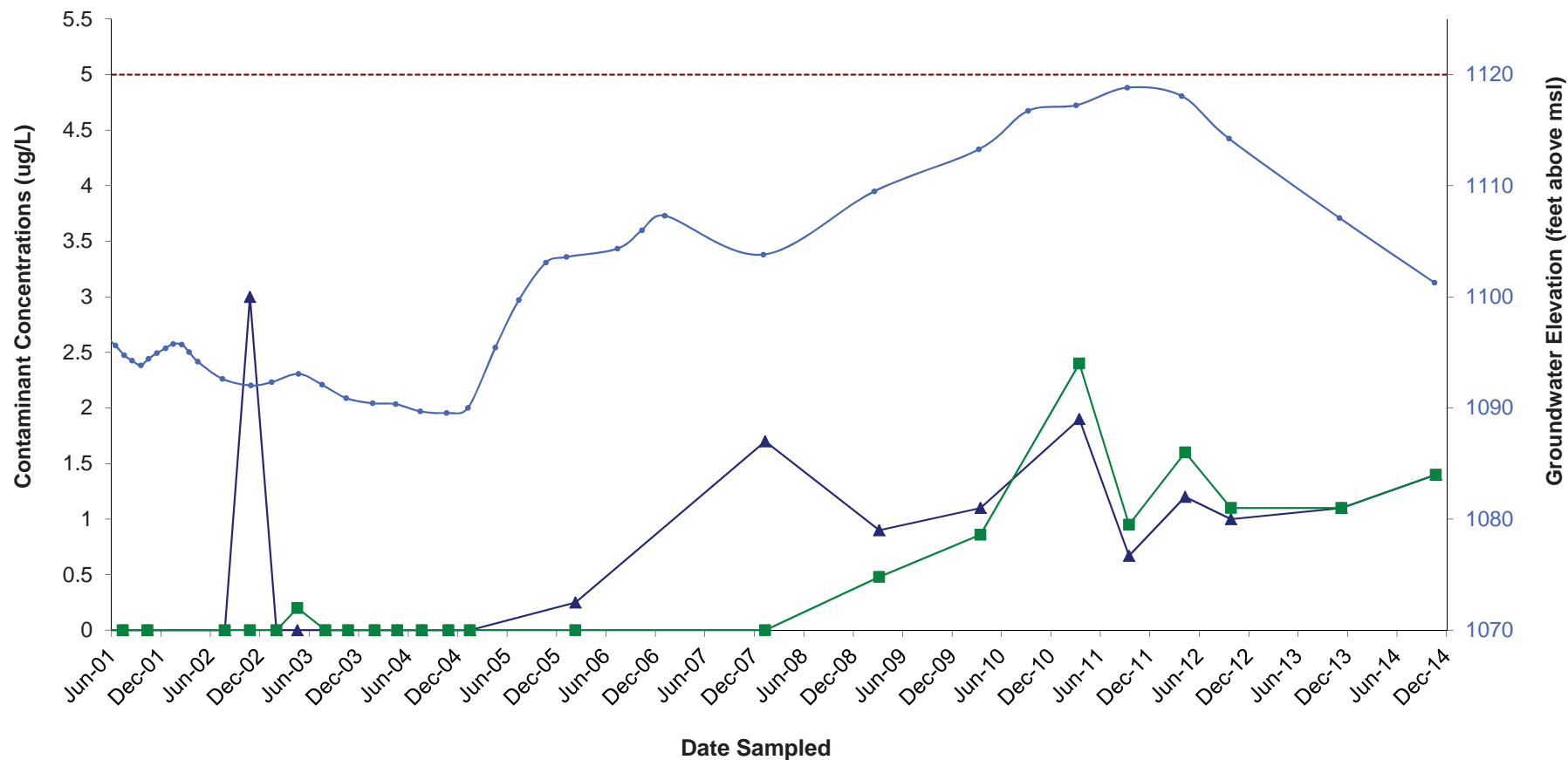
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
 South Indian Bend Wash Superfund Site, US EPA Region 9
 Tempe, Arizona

FIGURE 3-A
 Groundwater Potentiometric Map
 Upper Alluvial Unit
 Annual Sampling Event, 2014



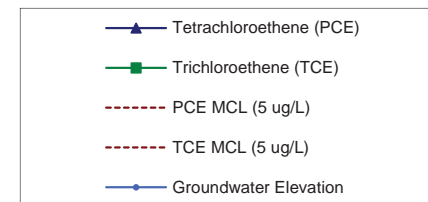
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 South Indian Bend Wash Superfund Site, US EPA Region 9
 Tempe, Arizona

FIGURE 3-B
 Groundwater Potentiometric Map
 Middle Alluvial Unit
 Annual Sampling Event, 2014



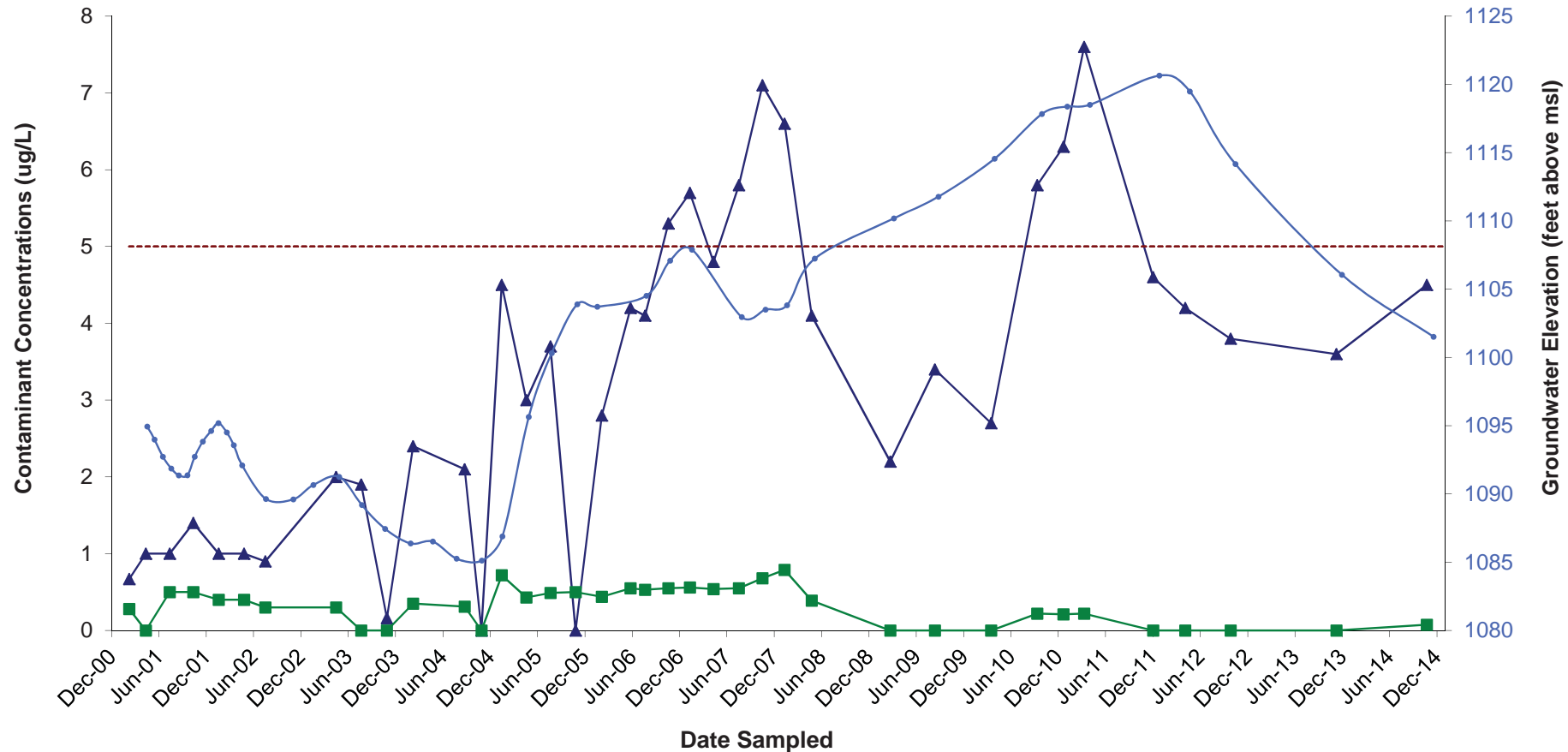
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-A
SIBW-60U
Central Plume



Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

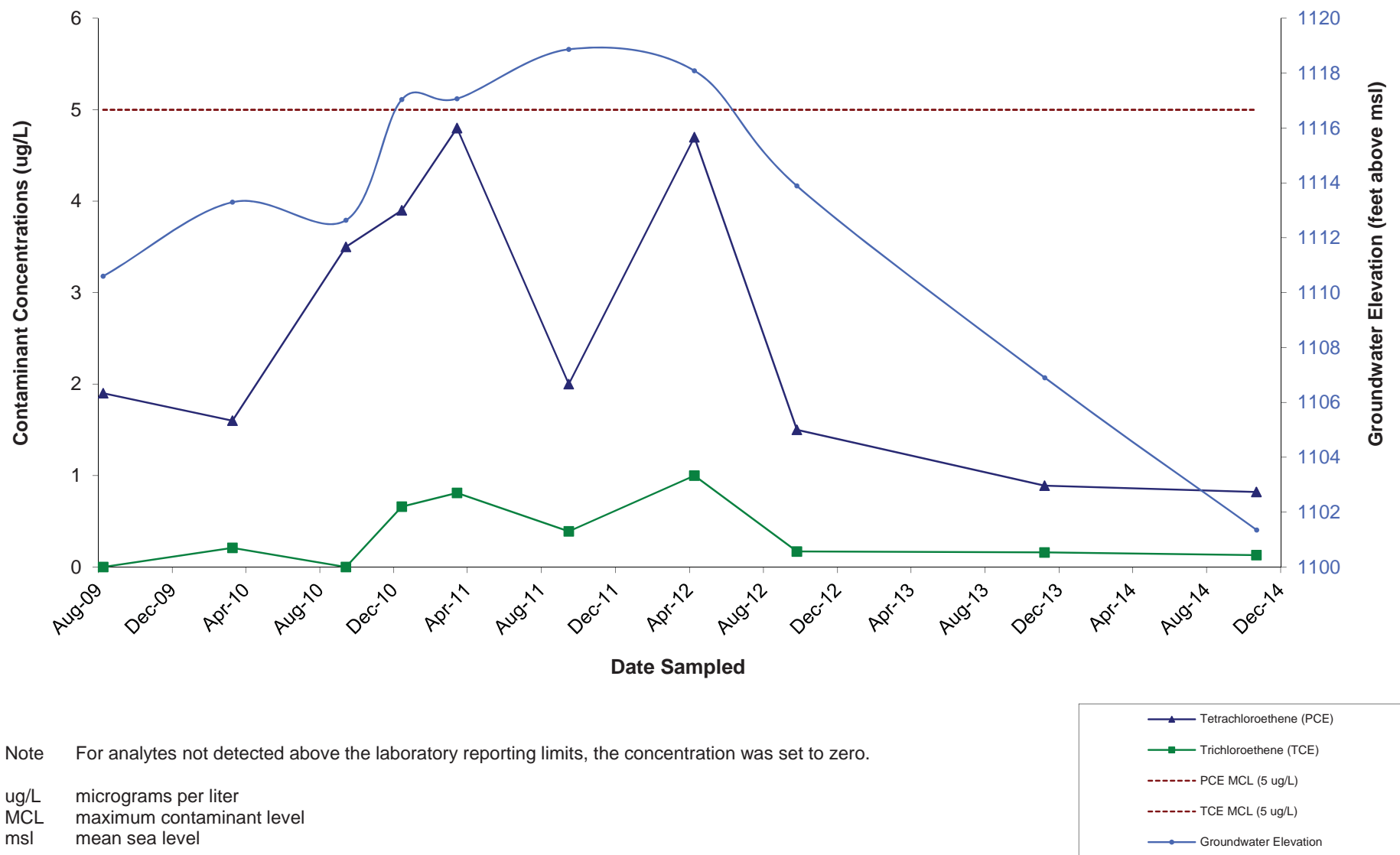
ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level

▲ Tetrachloroethene (PCE)
■ Trichloroethene (TCE)
--- PCE MCL (5 ug/L)
--- TCE MCL (5 ug/L)
● Groundwater Elevation



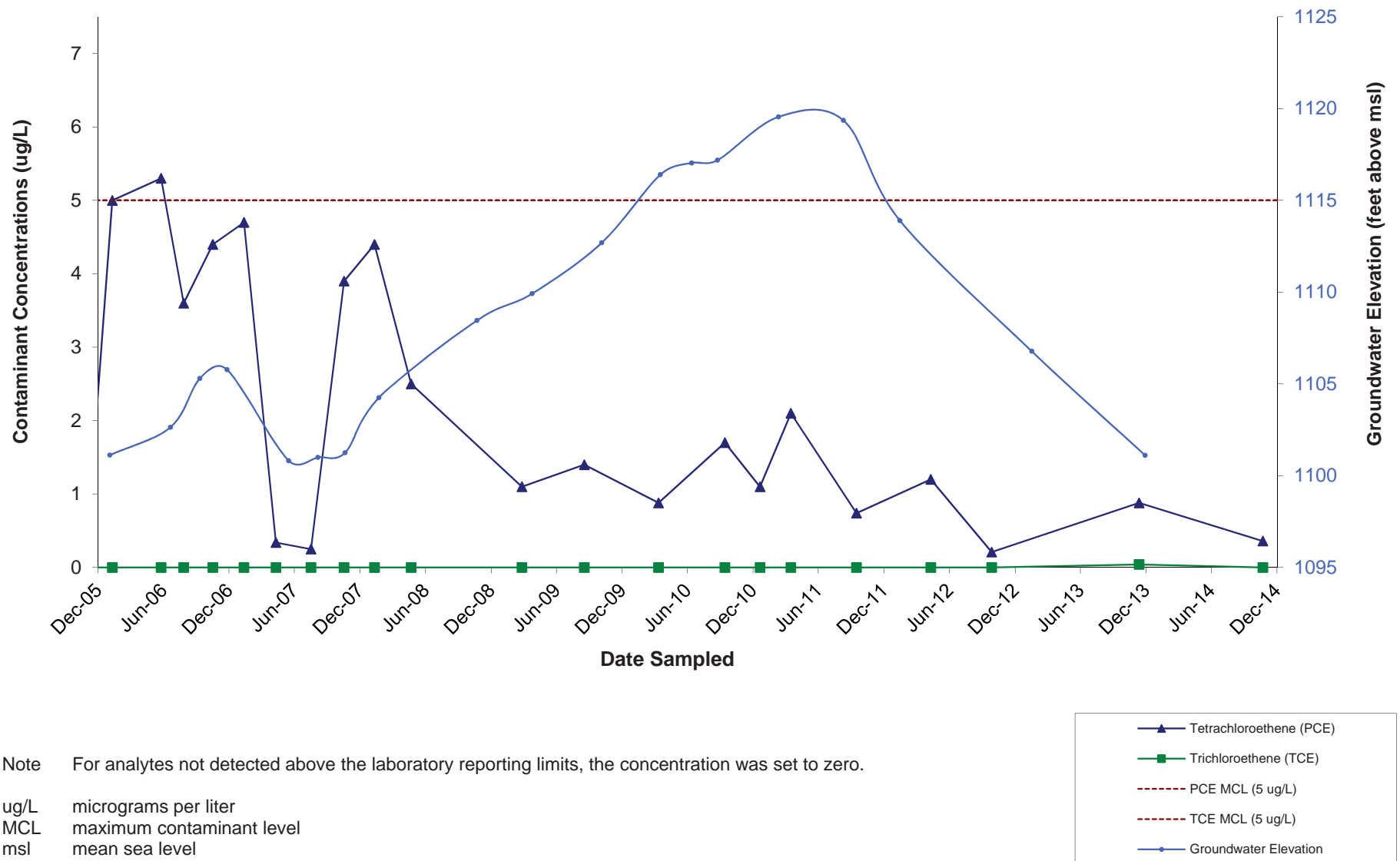
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-B
SIBW-61U
Central Plume



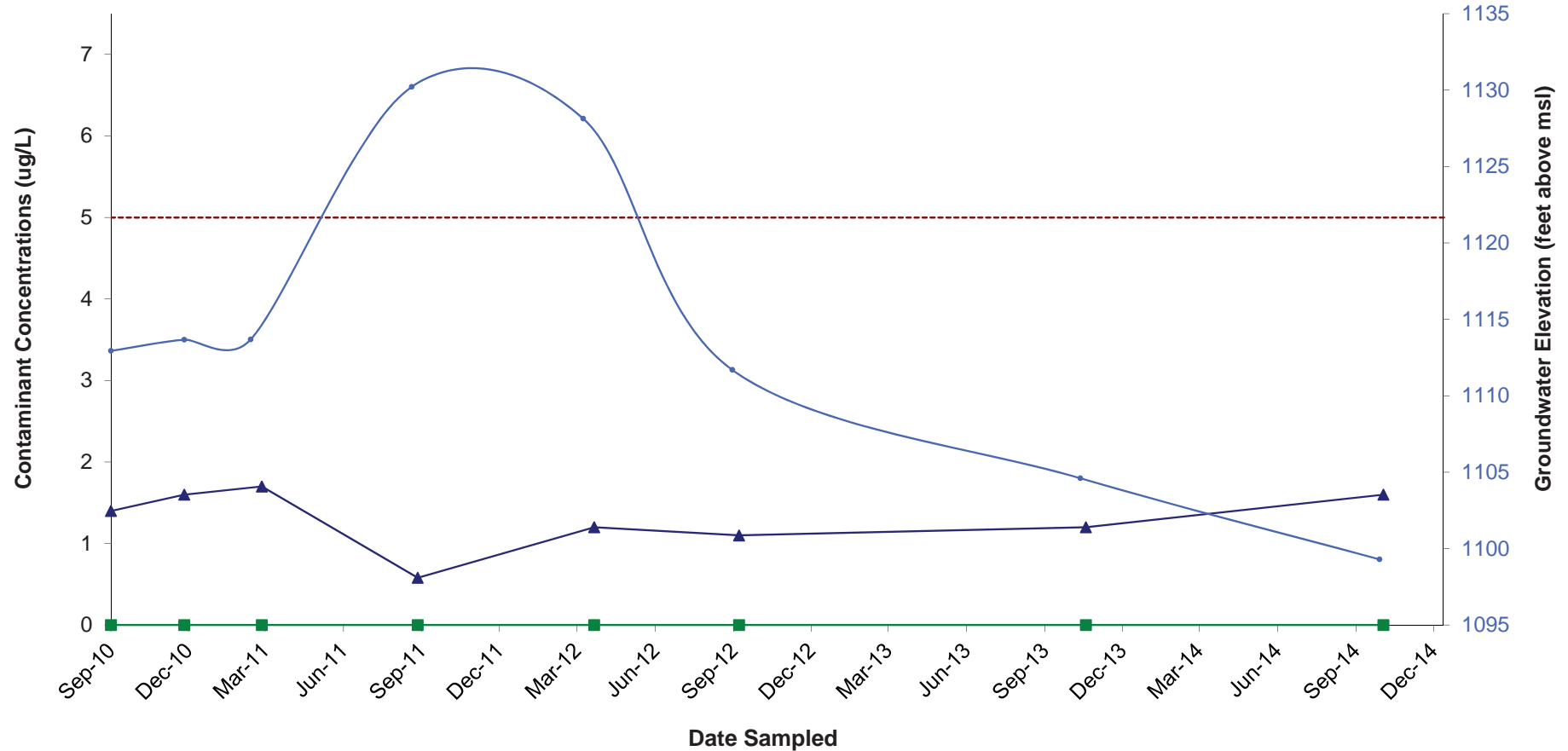
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-C
SIBW-64U
Central Plume



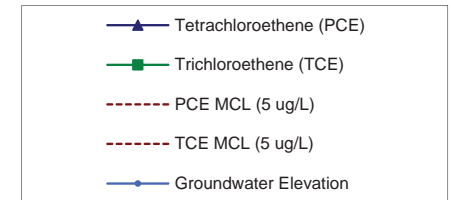
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-D
SIBW-65U
Central Plume



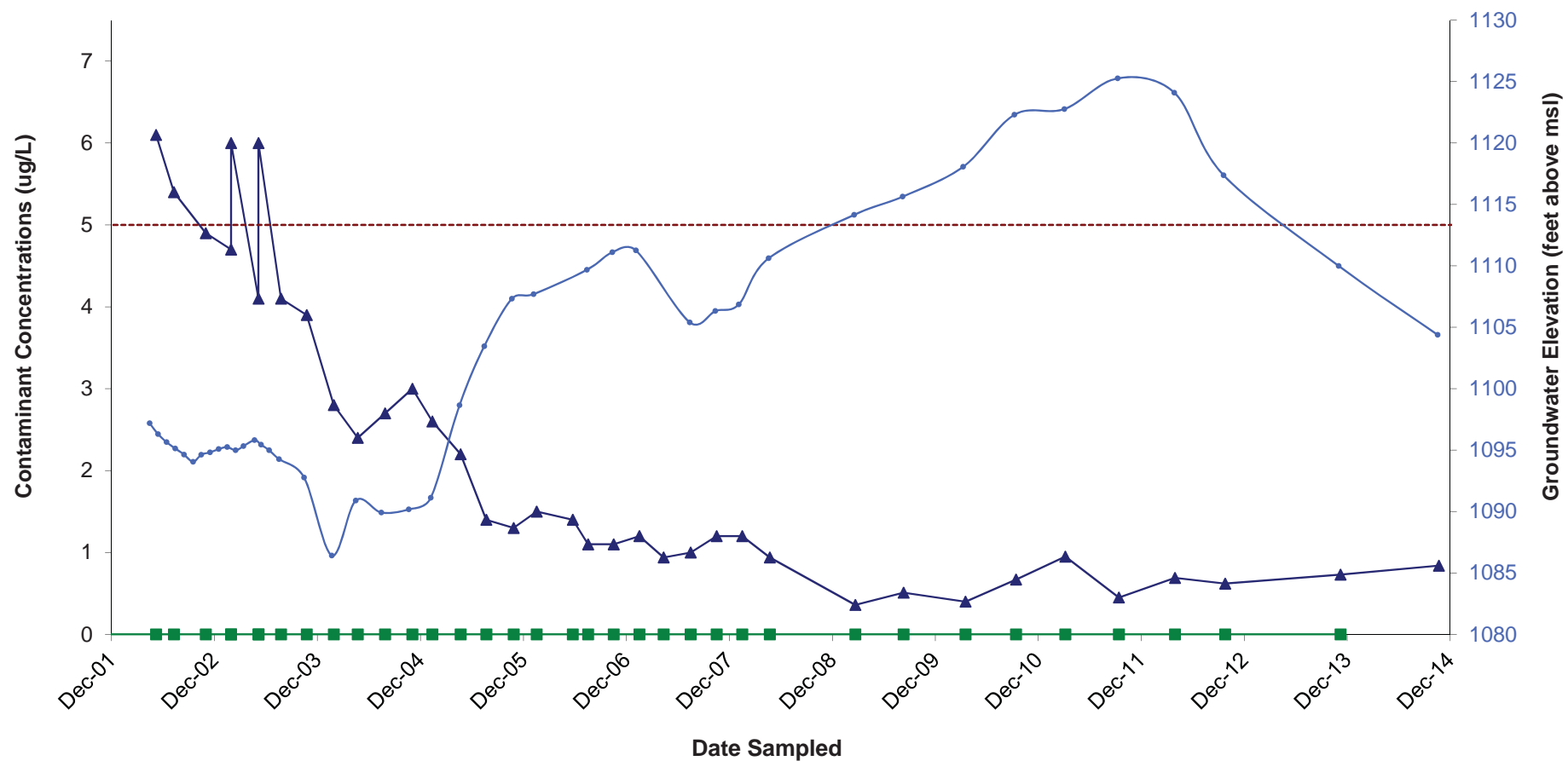
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



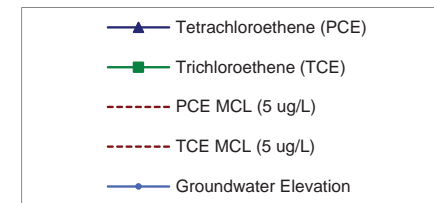
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-E
SIBW-66U
Central Plume



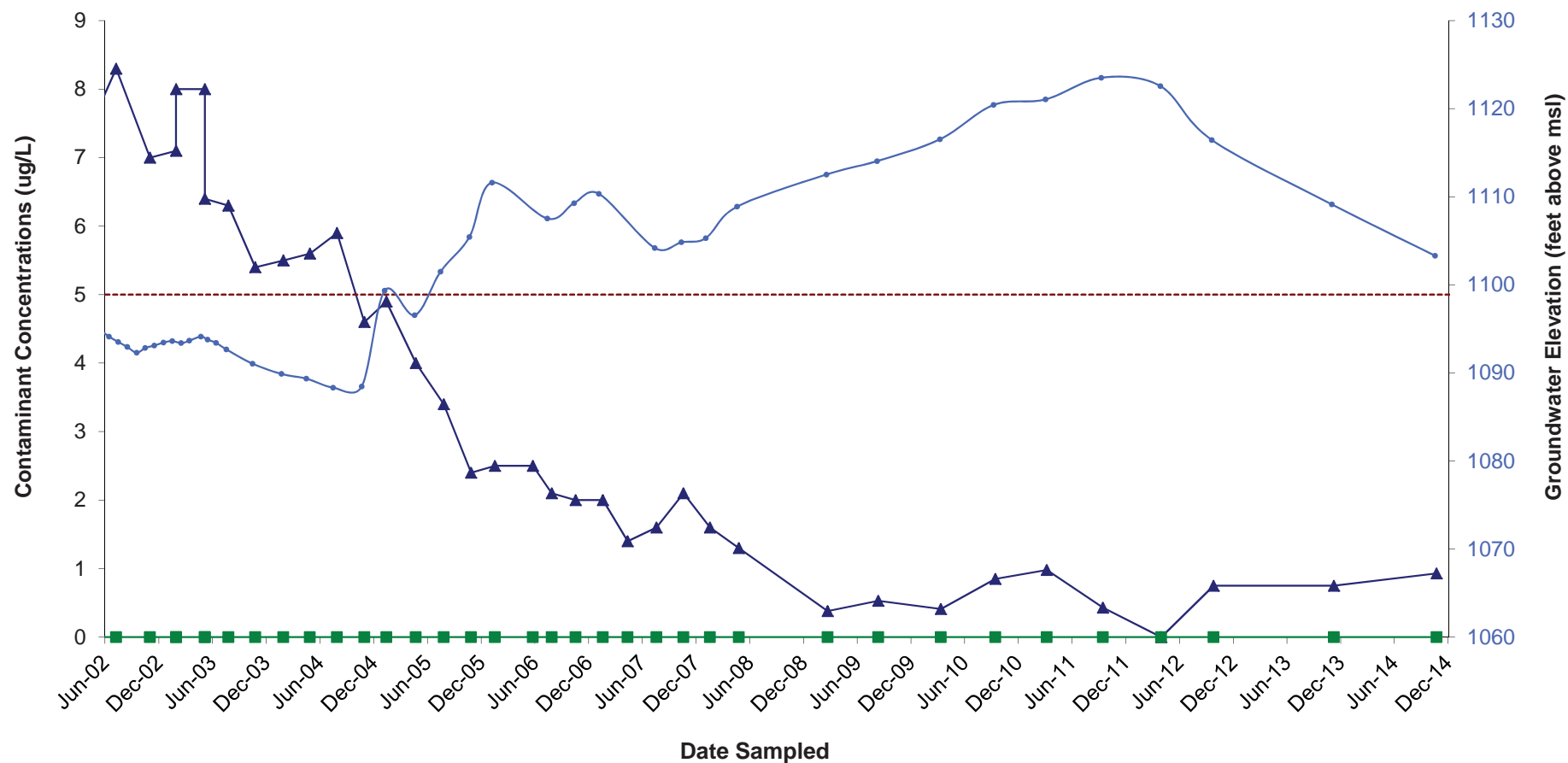
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



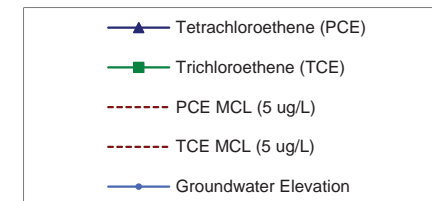
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-F
PD-2
Central Plume



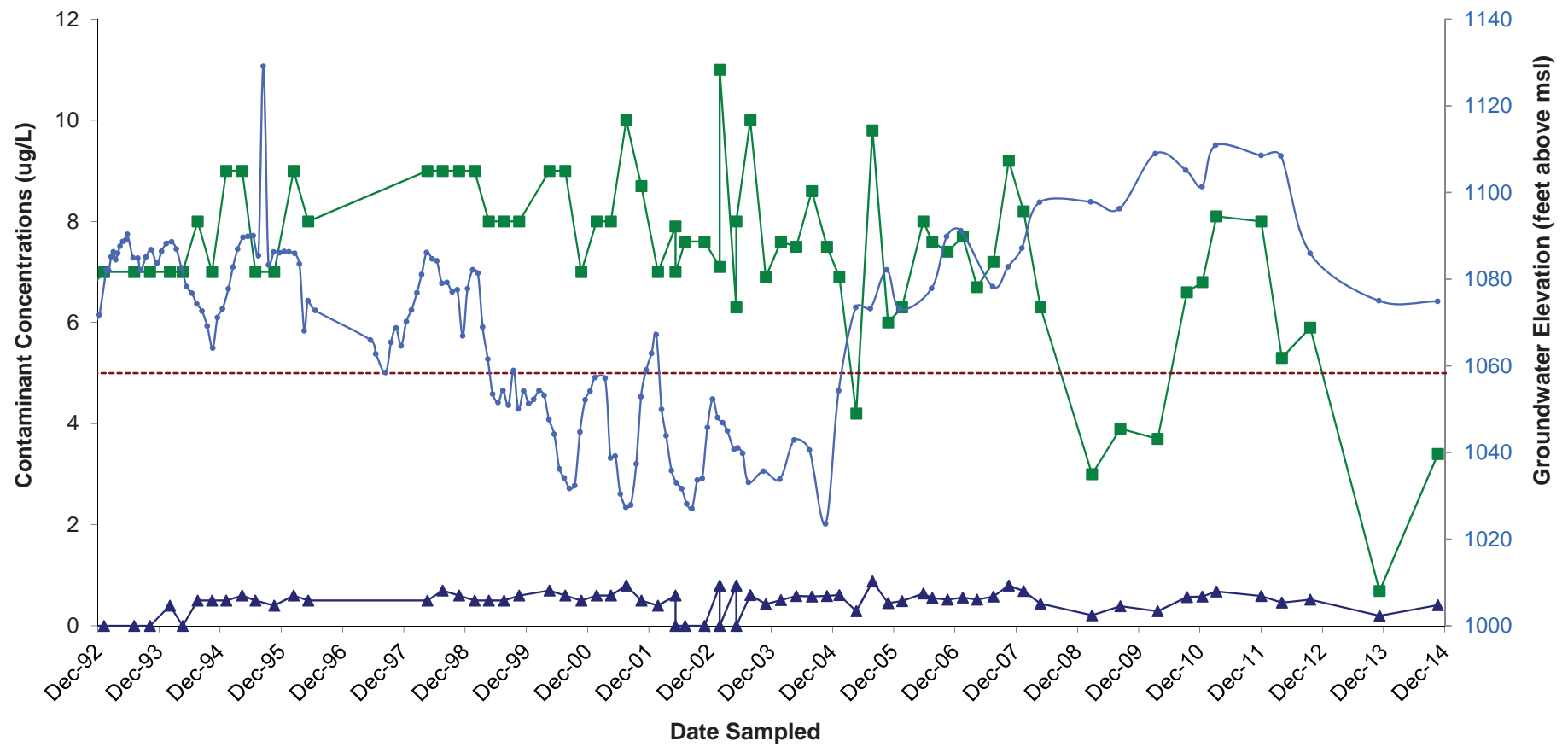
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



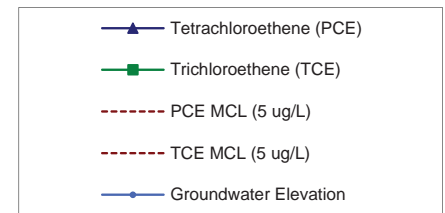
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-G
SW-1
Central Plume



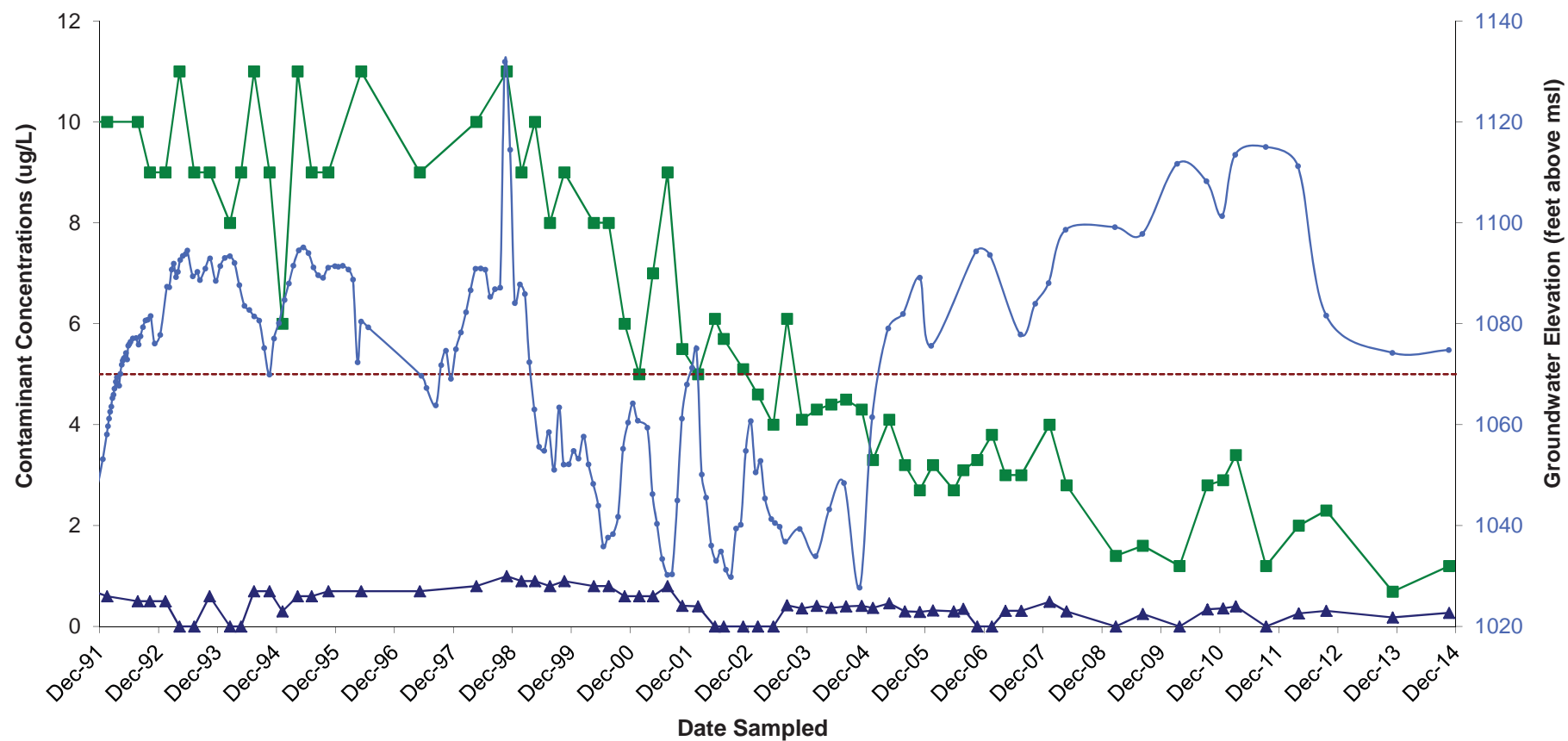
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



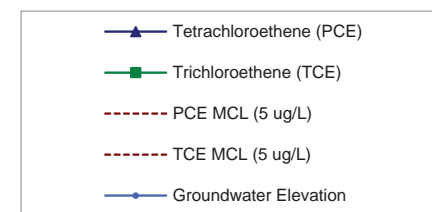
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-H
SIBW-11MC
Eastern Plume



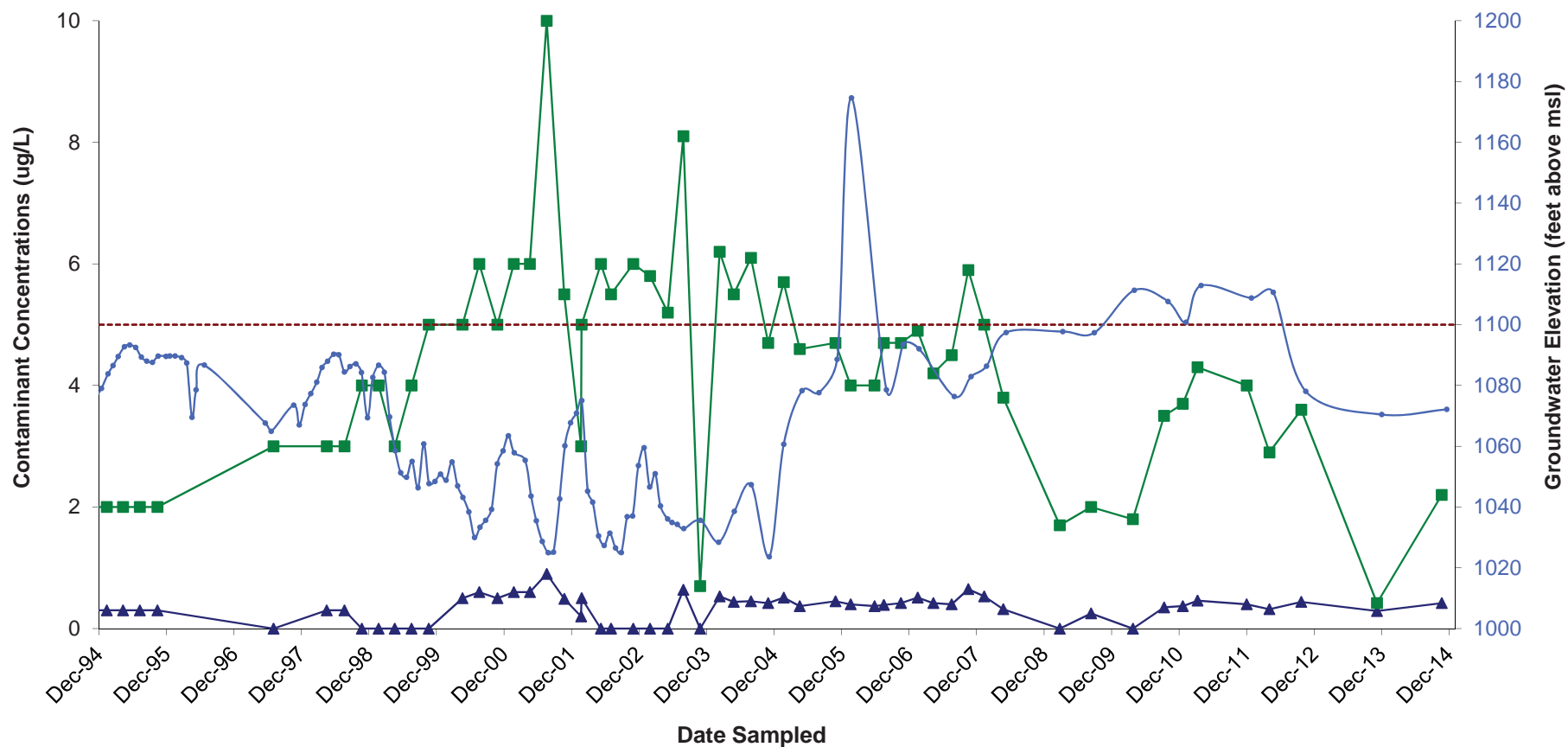
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



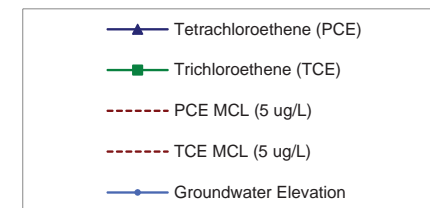
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-I
SIBW-13MC
Eastern Plume



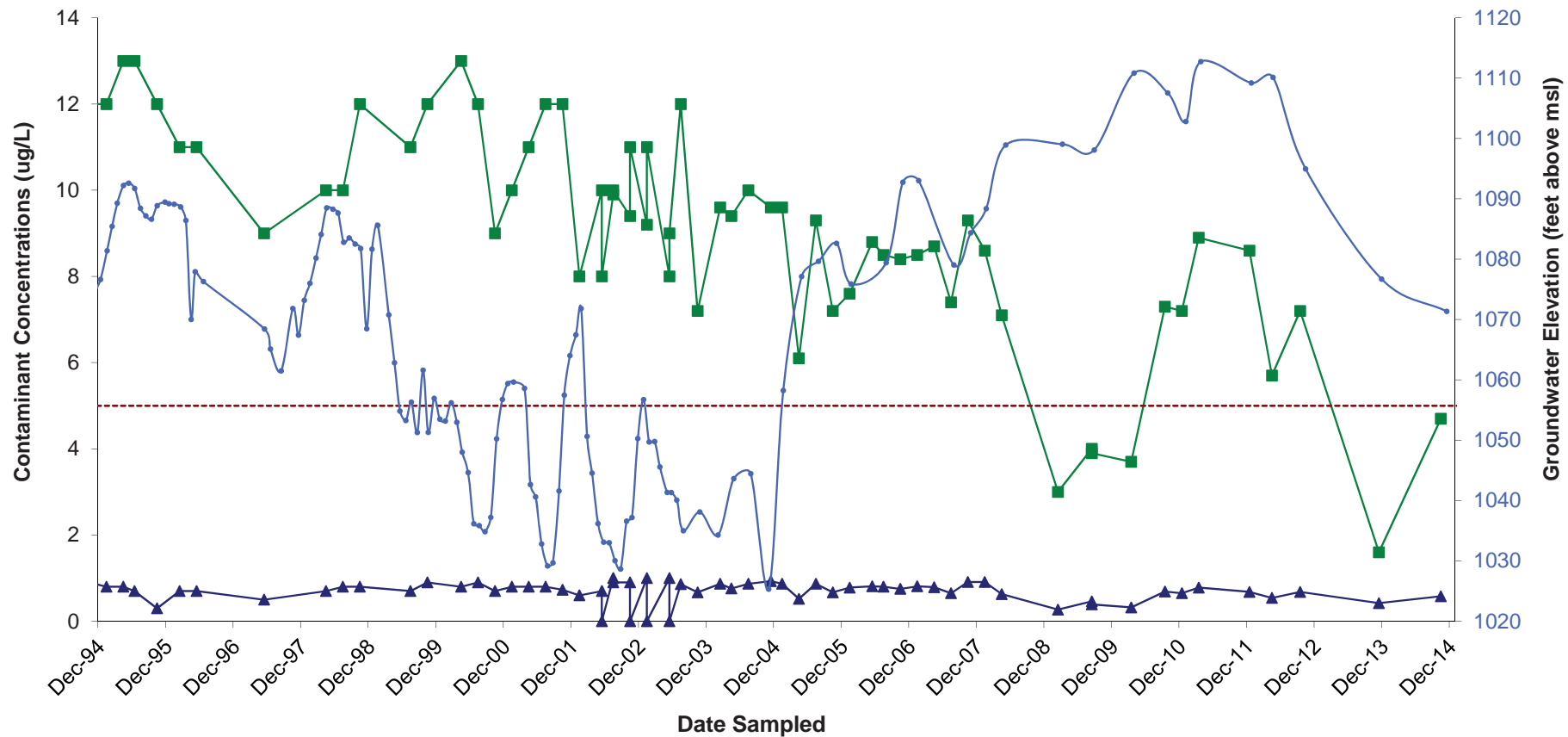
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



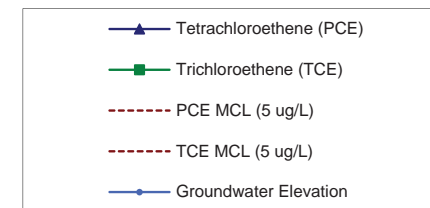
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-J
SIBW-56MC
Eastern Plume



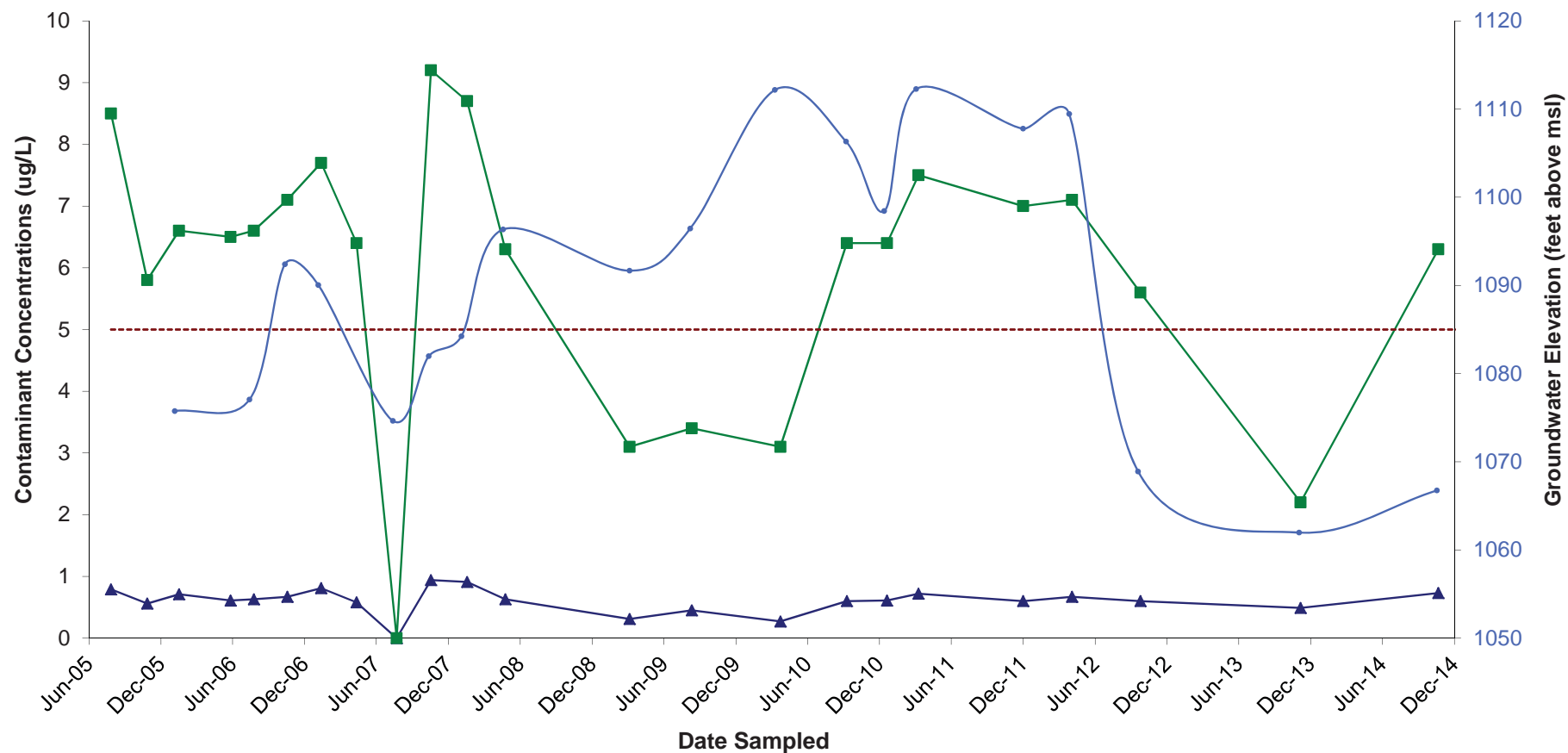
Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



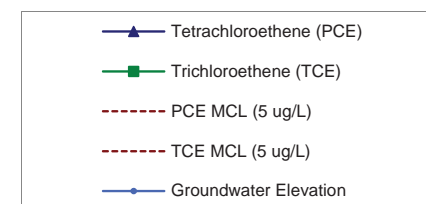
SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-K
SIBW-58MC
Eastern Plume



Note For analytes not detected above the laboratory reporting limits, the concentration was set to zero.

ug/L micrograms per liter
MCL maximum contaminant level
msl mean sea level



SIBW Monitored Natural Attenuation Monitoring Report - Annual Sampling Event 2014
Concentrations and Groundwater Elevations for SIBW Over Time
South Indian Bend Wash, Arizona

FIGURE 4-L
SW-3
Eastern Plume